

WATER-LINES



NEWS FROM THE WATER RESOURCES DIVISION
MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION • SPRING 1998

MISSION: TO PROVIDE THE MOST BENEFIT, THROUGH THE BEST USE, OF THE STATE'S WATER RESOURCES FOR THE PEOPLE OF MONTANA.

DEPARTMENT NEWS

FLINT CREEK RETURN FLOW STUDY

by Terry Voeller and Kirk Waren

IRRIGATORS HAVE LONG BEEN AWARE OF THE IMPORTANCE THAT AGRICULTURE RETURN FLOWS HAVE IN THEIR BASIN. In a sense, the aquifers storing return flows below the ground, can be envisioned as huge sponges that soak in water and then release this water as return flow at a later time. Most of this stored water comes from the so-called "inefficiencies" of irrigation. When water is diverted for irrigation, a significant portion of the water is not used by plants, but instead is either stored underground in the aquifer or returned directly into the stream.

Although high streamflows in the spring have always recharged aquifers linked to these streams, this amount is small when compared to the increased groundwater storage added by irrigation in many areas. In fact, irrigation has altered natural runoff patterns by lowering streamflows in the spring and summer and increasing them in the fall and winter. These increased streamflows in the fall and winter are directly attributable to the release of groundwater storage of return flows.

The importance of return flows in each basin is dependent on geology, the various water rights within a basin, and the method, location, and pattern of irrigation. For example, if irrigation takes place close to a stream, the water will return quickly to the stream making the storage potential limited. If irrigation occurs along high benches or

tributaries distant from the main stream, geologic conditions can slow return flows for several months.

An excellent example of return flows and their complexities exists in the Philipsburg - Drummond area, which Flint Creek runs through. Water rights were established in the basin prior to 1900 for both mining and agriculture.

In 1938, irrigation changed dramatically with the completion of the East Fork Rock Creek Reservoir by the predecessor to the Montana Department of Natural Resources and Conservation (DNRC). All of a sudden, considerably more water was being put into Flint Creek from the neighboring Rock Creek drainage. This water is paid for through contracts.

A large portion of the contract water seeps into the groundwater from flood irrigation and returns later for use farther downstream. But this return flow water is not a different color, and many downstream water rights are partially filled from this water, whether the users have contracts for it or not.

In 1993, Eugene Manley, a longtime rancher in the Flint Creek basin, and a number of other water



Flint Creek Basin

users asked the U.S. Bureau of Reclamation in Boise, Idaho, to conduct a return flow study and to assist in

(Continued on back page)

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PEAKS TO PRAIRIES:

A Conference on Watershed Stewardship

A CONFERENCE ON WATERSHED STEWARDSHIP WILL BE HELD ON SEPTEMBER 27-30, 1998, IN RAPID CITY, SOUTH DAKOTA, AT RUSHMORE PLAZA, HOLIDAY INN.

The conference will generate methods, ideas and examples of using a watershed approach to build communities and sustain the natural environment. Through stimulating interactive workshops, discussions facilitated by experienced professionals, field trips, hands-on activities, and case studies, participants will apply this new knowledge to their own situations and projects.

Keynote speakers will be Fee Busby, Deputy Chief of Technology, U.S. Natural Resources Conservation Service, and Wayne Elmore, National Riparian Service Team Leader, U.S. Bureau of Land Management. Monday's luncheon speaker will be Dan Kemmis, renowned author and Director of the Center for the Rocky Mountain West. Tuesday's dinner speaker will be Patricia Limerick, Professor of History, University of Colorado.

Interactive workshops will cover:

- ☐ Watershed grazing issues
- ☐ Floodplain management
- ☐ Wetlands
- ☐ Case studies and lessons learned from successful and failed watershed projects
- ☐ GIS/GPS and TMDL workshops
- ☐ Urban watersheds
- ☐ Source water protection
- ☐ Field trips assessing mining impacts and stream restoration and protection
- ☐ Principles and case studies concerning geomorphology
- ☐ Slope protection and erosion control

If you would like registration information, please contact:

Thorne Ecological Institute
5398 Manhattan Circle, Suite 120
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Phone: (303) 499-3647
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MARY ELLEN WOLFE AND THE MONTANA WATERCOURSE

MARY ELLEN HANNETT WOLFE WAS BORN IN ALBUQUERQUE, NEW MEXICO. She received a Bachelor of Arts in Secondary Education and Master of Arts in Political Science from the University of New Mexico in 1972 and 1985, respectively. She taught Civics, U.S. History, and American Problems in the Albuquerque public schools for five years before returning to graduate school to do advanced study of the American political process. Her graduate studies focused on the implementation of state and federal water policy and participatory democratic theory. She moved to Montana in 1983 with her husband and two sons.

Since moving to Montana, she has held various positions related to public policy education, policy analysis, and water resources education. As Assistant to the Public Affairs Specialist for the Montana State University (MSU) Extension Service (1985-1987) she co-authored *My Favorite Tax Is... A Primer on Montana Taxation*, and assisted with the development and composition of *Education for Public Decisions*, a national public policy education extension training module. As Research Associate for the 49th Parallel Institute on Canadian-American Relations at MSU (1987-1989), she was project manager of a comparative, transboundary water policy study sponsored by the Ford Foundation. She authored the paper "The Milk River: Deferred Water Policy Transitions in an International Waterway," (*Natural Resources Journal*, 1992,) which summarized the project findings. As a Research Assistant for the Local Government Center, MSU (1990-1991), she edited various publications on state and local government issues in Montana, including health policy, solid waste management, water infrastructure financing, and personnel management.

In 1991, she was hired as a Water Education Specialist for the Montana Watercourse, where she was initially charged with coordinating adult and youth water resource education projects including Project WET Montana and water rights workshops for adult audiences. While working part-time in this capacity, she authored *A Landowner's Guide to Western Water Rights*,



Mary Ellen Wolfe Photo by Jim Bond

published by the Montana Watercourse. She is currently the Program Director of the Montana Watercourse at Montana State University, Bozeman, where she is responsible for the program development and adult water education projects.

The Montana Watercourse was created in late 1989 after the first round of the State Water Planning Process revealed a critical need for water rights education. The mission of the Montana Watercourse is to foster lifelong stewardship of Montana's water by providing non-advocacy educational programs and materials for adults and youth.

The program has four basic components.

- ① **Know Your Watershed:** A community-based education program to advance citizens' awareness and knowledge of their local watersheds and better prepare them for informed stewardship of local, land and water resources.
- ② **Project WET Montana (Water Education for Teachers):** A teacher-training program that provides innovative lesson plans and teaching aides about Montana's water resources for Montana's youth.
- ③ **Volunteer Water Monitoring:** A statewide training program to promote knowledge and stewardship of aquatic resources by teaching local volunteers the skills needed to gather accurate, non-biased water quality information.
- ④ **Wetlands Information and Education:** A project to develop and provide information and training that will improve adult and youth awareness and understanding of the values and functions of Montana's wetlands. ④

EL NINO: WHAT'S IN STORE FOR MONTANA NEXT?

by Jesse Aber

ANYONE WHO SCOFFED AT EL NINO FORECASTS LAST SUMMER MUST CERTAINLY, BY NOW, BE CONVINCED OF THE OMINOUS POWER OF THE HIGH-PROFILE CLIMATE PHENOMENON. The hype became overbearing in the media, but the climatologists did a fine job of forecasting, and undoubtedly prevented a significant amount of loss of property and life.

Montana ended up with a strong temperature anomaly for January through March, with towns on the state's High-Line seeing monthly temperature averages as much as 10 degrees or more above the historical monthly averages. Helenans were not complaining about the pleasant winter with balmy afternoons and minimal snow shoveling. The National Weather Service reported that over the past 106 winters, Great Falls had the 26th warmest and 31st driest winter of record. The story was much the same across the state.

The price to pay, however, is below average precipitation nearly statewide. Mountain snowpack is only 60-70 percent of normal. Wheat farmers have been concerned about precipitation shortfalls in places such as the Golden Triangle wheat growing region.

Helenans are recalling the seemingly endless rains of the summers of 1993 and 1997, and saying there will be a price to pay for this easy winter. Payback time could be right around the corner judging from the past two weeks of chilly, wet weather. The real action is taking place about 2,000 feet in elevation above us in headwaters of river basins as snow keeps falling almost relentlessly. The recent moisture is making water equivalents of mountain snowpack rise 5 to 10 percent in addition to the 30-year average rate of accumulation. We could recover our mountain precipitation shortfall in a hurry if the current trend continues.

What is in store for Montana this spring and summer? According to Ken Mielke, Montana Area Director of the National Weather Service, climatology in North America is much harder to forecast for summer than winter. Although El Nino is still in place and continues to dog equatorial areas of the western hemisphere with storms and

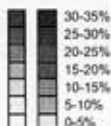
related havoc, it takes a backseat to the sun, which is the big weather maker for North America in spring and summer. As summer solstice approaches and the sun assumes a higher path across our southern skies, its power to generate convection heating and precipitation increases. El Nino, however, is not completely out of the picture, as it teams up with the sun to enhance its awesome force, energizing the jet stream that gradually migrates north until it stretches across Montana from

The sea surface anomalies are expected to gradually weaken with the approach of summer and could begin weakening more rapidly if easterly trade winds are re-established in the equatorial Pacific. Easterly trade winds push warmed waters away from the west coast of South America, allowing the upwelling of nutrient-rich cold water that fuels the coastal fishing economy. When climatologists see the return of the easterlies, they will forecast the breakdown of El Nino with more

Temperature Outlook
March-May



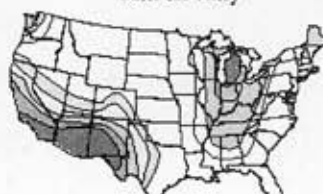
Probability
Anomaly
as shown
on map



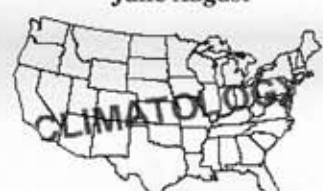
Temperature Outlook
June-August



Precipitation Outlook
March-May



Precipitation Outlook
June-August



west to east forming a precipitation highway from the Pacific. In winter, the jet stream usually meets the west coast at speeds of about 100 miles per hour. This year it reached over 200 miles per hour as California was battered with big storms. In summer, the jet stream travels slower, but El Nino will speed it up on the order of 30 to 60 extra miles per hour.

According to the Climate Prediction Center of NOAA and its April 16 30 and 90-day climate forecasts (which carry strong disclaimers concerning reliability) strong, warm El Nino conditions have been in place for March and April and are confidently forecast to continue through May. The impact of El Nino, even a strong one, becomes less well defined as we move to the warm half of the year. Warmer than normal temperatures in the west are forecast for the early summer, and warm conditions are forecast to continue through mid-June.

confidence. Some climate models are forecasting a cold phase episode, or La Nina, to begin at the end of 1998, while others will wait for the return of the easterly trade winds. Recent trends toward warmer than normal temperatures in the west, together with the warm sea surface temperatures frequently experienced along the west coast in spring, should enhance the chances of warmer than average conditions in much of the far west through late summer 1998 and in the northern Rockies in May, June, and July.

In addition to the disclaimers concerning the reliability of the long-lead forecasts is Montana's always highly variable climate. So, if you share these forecasts with your friends be sure that you mention that no one hedges their bets like climatologists, and whatever you tell them, don't mention that you heard it from me. Hope for a normal summer, but keep your rain gear and umbrellas in close reach. ☺

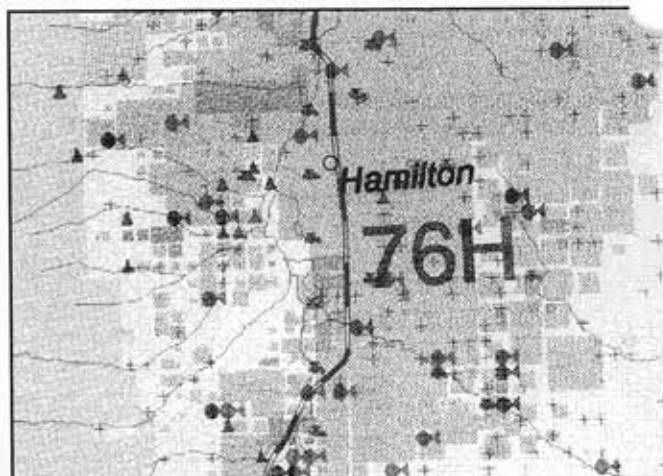
GEOGRAPHIC INFORMATION SYSTEM (GIS) USES IN WATER RESOURCES

by Tracey Turek

THE MISSOULA WATER RESOURCES REGIONAL OFFICE HAS BEEN TESTING GEOGRAPHIC INFORMATION SYSTEMS (GIS) TO ILLUSTRATE THE POTENTIAL OF THIS TECHNOLOGY IN MANAGING WATER RESOURCES AT THE LOCAL LEVEL. Our office created a spatial database for the water rights in the westside subbasin of the Bitterroot River (76HF), which was decreed by the Montana Water Court in January 1998. We incorporated our claimed water right data with other coverages or layers which include roads, hydrography,

the public land survey system, and the Ravalli County water resources survey data. We can view, on a computer screen, a map of irrigated acreage and simultaneously show a table of all the pertinent water right information related to each parcel.

This GIS technology allows water users to better understand



Westside subbasin of the Bitterroot River, 76HF.

MONTANA'S SURFACE WATER AND GROUNDWATER CLOSURES

by Ann Glubczynski

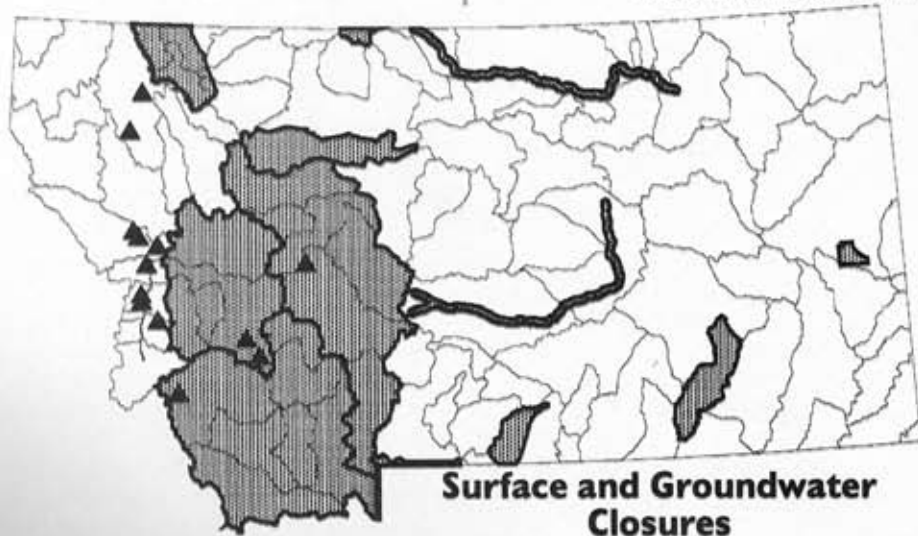
WHEN WATER QUANTITY OR QUALITY ON A WATER SOURCE BECOMES A PROBLEM, ONE OF THE WAYS MONTANANS CAN DEAL WITH THE ISSUE IS TO CLOSE THAT SOURCE TO FURTHER APPROPRIATIONS OF WATER. This is called closing a basin, and there are currently 26 drainage basin and groundwater aquifer closures in the state of Montana. They are indicated on the map below by the shaded areas and black triangles.

The Water Rights Bureau has a new booklet coming soon that

highlights the issue of closing basins to new water appropriations. *Montana's Surface Water and Groundwater Closures* discusses the types of closures and how new uses of water can be controlled or limited, how to go about closing a drainage basin or groundwater aquifer, and details of all the basin closures in the state.

This booklet will be available to the general public at the Water Resources Regional Offices and from the Water Rights Bureau. ☺

Map by Jane Horton - DNRC GIS Specialist



their individual water right claims in relationship to any other claims within their drainage basin. Color maps can be printed to show priority among users, the location and extent of irrigated lands, and virtually any scenario relating to irrigation water rights within the basin. Both the general public and professional consultants have utilized our project to gather information and generate maps for the current objection period. We anticipate extensive use of this database for assisting the Montana Water Court in resolving objections.

The project has been successful in showing how this technology can be created and utilized at the local level as part of the adjudication process. The next step is to show, through utilizing developing GIS coverages of land ownership by the counties and the Department of Revenue, how we could eliminate our current water rights ownership transfer process. Determining water right ownership electronically would greatly reduce the staff time and resources required and increase our accuracy and efficiency. Converting our current mainframe system and paper files into a graphically integrated relational database system with very powerful analysis capabilities could revolutionize our service to the state and the public. Our data could be easily accessible and utilized by other departments and the general public. We are currently working with the GIS staff in Helena and other regional offices to promote GIS throughout the Water Resources Division. ☺

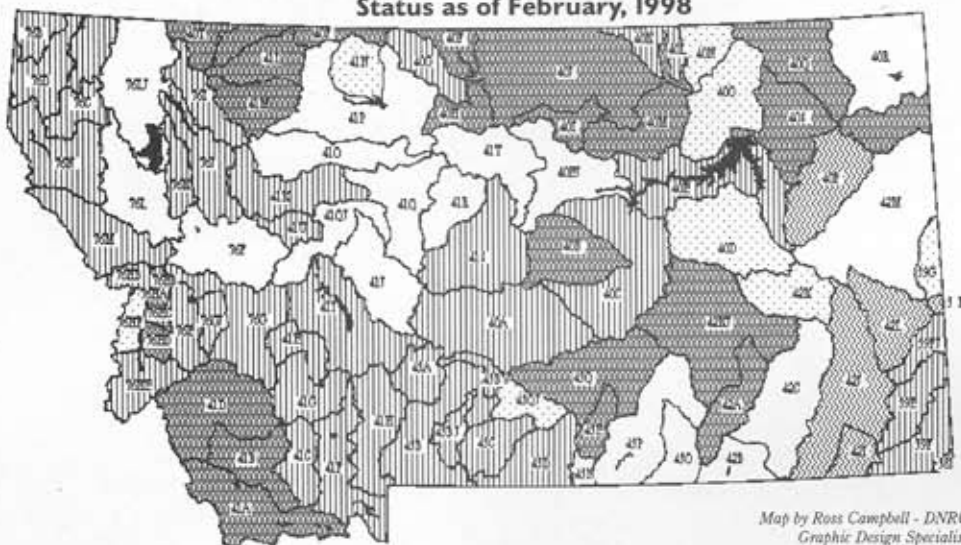
BASINS IN THE SPOTLIGHT

by Rita Nason

- On January 14, 1998, the Montana Water Court issued a Preliminary Decree for the Westside of the Bitterroot River, Sub-basin 76HE. The deadline for filing objections to claims in this basin is set for July 13, 1998.
- The Objections Notice for the Milk River below Whitewater Creek including Porcupine Creek (Basin 40O) was mailed February 4, 1998. The deadline to file a Notice of Intent to Appear was April 6, 1998.
- The Helena Water Resources Regional Office has completed claims examination in the Big Hole River (Basin 41D). DNRC anticipates sending its Summary Report to the Water Court by June 30, 1998.
- At the request of the Montana Reserved Water Rights Compact Commission, the Bozeman Water Resources Regional Office is focusing claims examination in the Red Rock Lakes area of Basin 41A.
- On September 5, 1997, the Water Court directed DNRC to commence examination of state-law-based claims filed within the boundaries of the Blackfeet Reservation in Basins 40E, 40T, 41L, and 41M. The Havre Water Resources Regional Office anticipates completion of claims examination of these four basins by April 1999.
- On August 29, 1997, the Water Court directed DNRC to examine the claimed acres irrigated and places of use for all irrigation claims in the Judith River (Basin 41S). The Lewistown Water Resources Regional Office is currently undertaking this project.
- As ordered by the Water Court on November 5, 1995, the Billings Water Resources Regional Office has completed examination of certain claims within the boundaries of the Crow Reservation in Basins 43E and 43Q.

For more information about these and other basins, contact your local DNRC Water Resources Regional Office or the Montana Water Court in Bozeman.

Montana General Adjudication Status as of February, 1998



Map by Ross Campbell - DNRC
Graphic Design Specialist

Legend

- Final Decree (6 basins)
- Preliminary Decree (8 basins)
- Temporary Preliminary Decree (35 basins + subbasins)
- Basin Currently Being Examined (19 basins)
- Basin Not Yet Examined

STATE WATER PROJECTS BUREAU SELLS THEBOE PROJECT

by Tim Kuehn

THE THEBOE LAKE PROJECT, PREVIOUSLY OWNED BY THE DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION, WAS SOLD ON JANUARY 7, 1998. The property, located west of Choteau, Montana, was auctioned by oral public bidding to the owner of adjoining land for \$201,500.

The Theboe Project entails 150 acres of property including 90 acres of unimproved rangeland and a reservoir covering an additional 60 acres. The project was built in the 1930s to divert and store water from Willow Creek for irrigation purposes. Flooding during the spring of 1964 destroyed the diversion structure, and the project has not been operated since that time.

The reservoir is classified as high hazard, meaning that, if the reservoir were filled and the dam failed, the

resulting flood could result in the loss of life downstream. Significant repairs are needed in order to obtain the necessary Dam Safety Operating Permit required to fill the reservoir.



Theboe Lake Project

Photo by Tim Kuehn

The project was sold due to liability concerns, administrative costs, and the fact that the public was not deriving any benefits. Proceeds from the sale were deposited in the Renewable Resource Grant and Loan Account.

DROUGHT IN 1998?

by Jesse Aber

THE MONTANA DROUGHT ADVISORY COMMITTEE (DAC) CHARACTERIZES THE PROBABILITY FOR DROUGHT THIS SUMMER AS "MODERATE." That was the conclusion of *The Governor's Report: The Potential for Drought in Montana for 1998*, a report prepared by DAC.

The report concludes that current water supply forecasts call for below average mountain snowpack runoff both east and west of the Continental Divide for spring of 1998. Dryland agriculture is the primary area of concern due to low soil moisture in the northcentral, central, and northeast climate divisions.

For the period of March 1 to 24, precipitation was above average state-wide, with the northeast division receiving 250 percent of average. The northcentral division rebounded from a moderate drought in mid-October 1997 to a moist spell in March 1998, and the central division from incipient drought to a moist spell. The Golden Triangle wheat region is located within these two divisions.

Reservoirs are in very good shape, with contents at average or above average, at all U.S. Bureau of Reclamation projects and near average at state-owned projects, with no shortages expected for water users. Water users in river basins without storage projects face a more tenuous water supply outlook since the water content of mountain snowpack statewide ranges from about 75 to 85 percent of average with the exception of the Yellowstone River basin, which is rated as average.

Climatological authorities are pointing to a demise of El Niño sometime this summer or fall, with some going as far as to say that its sister, La Niña (wet and cool like 1996-97), will return in late 1998. However, records for Montana El Niño years show that precipitation shortfalls often drag out into June before average monthly moisture returns.

The report is available on the Internet at <http://www.dnrc.mt.gov/wrd/govrpt.htm>. ☐

TOSTON WETLAND RESTORATION PROJECT

by Walt Anderson

THE DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION WILL DEVELOP APPROXIMATELY 10 ACRES OF WETLAND HABITAT CALLED THE TOSTON WETLAND RESTORATION PROJECT (TWRP). The TWRP is a federally mandated wetland mitigation project resulting from the development of the Broadwater Power Project. Broadwater, a state-owned hydropower plant on the Missouri River, is licensed by the Federal Energy Regulatory Commission to generate power. In the project's

replacing wetland vegetation with more valuable forage species. DNRC has purchased a conservation easement on the property that grants exclusive right to develop a shallow impoundment 10 to 13 acres in size and other habitat improvements.

On-site materials will be used to build the impoundment. Spoil piles leftover from drain ditch excavation will be reshaped and excess material used to build an additional 2,700 feet of low elevation berm. The total length of the berm that forms the shallow pond will

be approximately 4,000 feet. A drain system will be installed to intercept groundwater flows from the upper bench and pipe them into the impoundment. If the groundwater supply is insufficient to fill the pond, supplemental water will be supplied from the nearby



View of the Toston Wetlands Restoration project area.

Photo by Jim Beck

license, DNRC is required to replace wetland habitat destroyed by raising the project's reservoir level to increase power production. Wildlife biologists estimated that approximately 10 acres of wetland habitat were flooded because of the increased water level.

The TWRP is designed to enhance or restore the existing wetland characteristics of 36 acres of property near Toston, about 5 miles downstream from Broadwater. The property is located at the base of a slope dropping down from an upper bench area. In the area, groundwater upwells to the surface and saturates the soil, supporting a dense cover of wetland vegetation. Historically, landowners attempted to drain the property by digging drain ditches in hopes of

Broadwater-Missouri Canal. All inflow will be monitored and recorded using a battery-operated flowmeter and recorder installed in a shallow manhole. Other various concrete structures are also included for water supply and control.

The project was designed by Jim Beck, Helena Regional Engineer, with assistance from Walt Anderson, Broadwater Power Project. Both engineers worked together to prepare the contract documents and advertise for bids. DNRC's successful bidder, Rowe Construction, hopes to begin construction in April and should complete the project in 45 days or less. DNRC will supervise construction with on-site compaction testing provided by Braun Intertec. ☐

DAM SAFETY PROGRAM UPDATE

by Michelle Lemieux

EXCITING THINGS HAVE BEEN HAPPENING WITH THE DAM SAFETY PROGRAM!

First, we have a new Dam Safety Engineer. Kurt Hafferman, formerly of the State Water Projects Bureau, who started with the Dam Safety Program in January. Kurt, who is a licensed professional engineer, brings with him extensive experience in civil engineering design and construction. Kurt has immediately stepped up to the plate, taking over the development of a new spillway standard, dam safety oversight of the Tongue River Dam, and supervision and review of several upcoming construction and design projects.

For those of you not familiar with the Dam Safety Program, a little background may be in order. The Dam Safety Program regulates all private, local government, and state-owned high hazard dams. The term "high hazard" does not refer to the condition of the dam; rather, it is an indication of the potential for loss of life downstream should the dam ever fail. Excluded from regulation are federally-owned dams and dams located on federal lands, such as Canyon Ferry, Fort Peck, Libby, and dams on U.S. Forest Service property. The Dam Safety Program has two Helena-based engineers: Michele Lemieux, who specializes in geotechnical engineering, and Kurt Hafferman, who specializes in hydraulics and hydrology. They are assisted by their supervisor, Laurence Siroky, who initiated the program back in 1985, and five regional engineers.

The most important issue facing the Montana Dam Safety Program at this time is the development of new spillway standards. Past standards were based on the occurrence of an event called the probable maximum flood. The trend in the dam safety community has been to move toward

risk-based standards. A risk based standard takes into account the loss of life that may be expected, should the dam fail. In other words, a dam with a large population located immediately downstream would be required to be able to pass a very large flood through the spillway without failing. A dam with a very small population located far

developing. This is particularly important in older dams. There are four primary methods to monitor seepage: (1) measurement of seepage at toe and abutments of drains, (2) collection and measurement of flowing seepage using weirs and flumes, (3) photographs and regular inspection of nonmeasurable seepage, and (4)

measurements by piezometers and monitoring wells. The last method is one of the most important. Unfortunately, the installation of monitoring wells can be very costly for dam owners. It will be some time before we will be able to have adequate monitoring on all dams.

In order to provide training and improve communication between dam owners, regulators, and engineers, the Dam Safety Program hosts an annual conference or seminar. This year's conference will be held in Missoula on April 28, 1998, at the Holiday

Park Hotel. Presentations will be on a wide variety of dam-related topics. If you need information on this conference or would like to subscribe to the Dam Safety Program's semi-annual newsletter, please call either Michele Lemieux at (406) 444-6613 or Kurt Hafferman at (406) 444-6664. ☺



Photo by Jim Bond

Pictured from left to right: Kurt Hafferman and Michelle Lemieux, Dam Safety Engineers; Laurence Siroky, Bureau Chief, Water Operations Bureau.

below the dam could be designed to pass something significantly less. The difference can mean millions of dollars to a dam owner! A committee has been created to develop a risk-based standard. They have been meeting regularly for the past six months. The committee consists of dam owners, state and federal regulators, engineers, scientists, and downstream residents. Some great progress has been made! It is expected that a new standard will be out for public review and comment by May of 1998.

Another important issue being addressed is the implementation of seepage monitoring plans for all high hazard dams. The Dam Safety Program is requiring that all owners begin monitoring the seepage out of their high hazard dams. All dams leak water to some degree. This "seepage" is generally okay as long as it is controlled and soil material is not being moved. Monitoring seepage as reservoir levels increase and decrease helps determine whether a problem is

DAM SAFETY PROGRAM

hosts annual conference

**This year's conference
will be held in
Missoula on April 28, 1998
at the
Holiday Park Hotel**

**If more information please call
Michele Lemieux at (406) 444-6613
or
Kurt Hafferman at (406) 444-6664**

FLINT CREEK RETURN FLOW STUDY

(Continued from page 1)

developing a management plan for Flint Creek. Because this study would require a great deal of "on-the-field" data collection, several other agencies with offices closer to Drummond and Philipsburg were asked to help. They included the U.S. Geological Survey, the U.S. Natural Resources Conservation Service, and the DNRC.

To oversee this study, the Granite County commissioners formed a watershed resources committee in 1994. This committee was made up of six ranchers within the Flint Creek basin who have water rights from both East Fork Rock Creek Reservoir and from Flint Creek itself. These ranchers donated a tremendous amount of time and resources to ensure that the end result would be beneficial to all water users within the basin.

Within the Flint Creek basin, over 25,000 acres of alfalfa, alfalfa grass hay, and wild hay are irrigated. The annual

inflow into the basin can range from lower than 120,000 acre-feet to over 180,000 acre-feet, depending on moisture conditions. Contingent on weather, the amount of water permanently lost to the system from consumptive irrigation use can range from 30,000 to 40,000 acre-feet.

During May and June, flows are reduced by approximately 25,000 acre-feet due to irrigation; much of this decrease is caused by aquifer recharge. By August, when most aquifers are filled and streamflows are typically lowest, flow reduction from irrigation is between approximately 6,000 and 10,000 acre-feet.

In the Flint Creek basin, modification of water rights from flood to sprinkler systems would reduce water availability if more land were put into irrigation. Because of the availability of stored water in East Fork Rock Creek Reservoir, conversion from flood to sprinkler irrigation systems on existing irrigated lands would have minimal impact to ranchers who have contracts for this water. But the impact

to decreed water right users, who have benefited from flood irrigation's return flows, would likely be significant during drought years.

The most dramatic effects of return flows are observed after irrigation is ceased. During a dry year, flows are more than doubled in October and November from return flows. These return flows rapidly drop off through the winter but remain measurable into the next irrigation season.

Evaluation of basin inflow and outflow shows all inflow into the Flint Creek basin can be accounted for by outflow and crop use.

It must be emphasized that the value of return flows is very dependent on basin characteristics. In many areas, return flows are a clear detriment to water quality. Examples range from the Muddy Creek erosion problem created by irrigation on the Fairfield Bench to the salinity problems in the Lower Musselshell River. These problems are directly attributable to return flows. ☐



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MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION WATER RESOURCES DIVISION

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